

THURSDAY, FEBRUARY 6, 1908.

TRANSPIRATION AND ANATOMICAL
STRUCTURE IN TROPICAL PLANTS.

Der Einfluss des Klimas auf den Bau der Pflanzengewebe. Anatomisch-physiologische Untersuchungen in den Tropen. By Dr. Carl Holtermann. Pp. viii+249; plates. (Leipzig: W. Engelmann, 1907.) Price 12 marks.

DR. HOLTERMANN'S investigations, mainly carried out in Ceylon, include a long series of experiments on the transpiration of different tropical plants. His tables show great variations in the amount of transpiration for the same plant during the same hours of different days, and these are in many cases not explained by the differing temperature and relative humidity, which are the only other data given. Thus, for instance, in the case of *Canna indica*, between 9.40 a.m. and 5.40 p.m. on January 11 (with a relative humidity of 61 and a temperature of $25^{\circ}4$ at 10 a.m.), the transpiration was 0.37 gr. per hour per sq. dm. of leaf surface, while on January 17, between 9.45 a.m. and 5.30 p.m. (R.H. 63, temp. $26^{\circ}2$, at 11.15 a.m.), the transpiration was 0.92 gr. per hour per sq. dm., and on January 18 between 9.15 a.m. and 3.30 p.m. the transpiration was 2.60 gr. per hour per sq. dm. (no humidity or temperature data are given within the period of the experiment, but judging from the late afternoon figures the day did not differ much from the others). This, though an extreme case, is only one out of several similar ones, and the effect of such figures on the reader is decidedly bewildering, though the striking variations may be explicable by changes of insolation, or the irregular occurrence of drying winds. As they stand, the author's figures only demonstrate that the transpiration of the plants studied exhibited startlingly wide fluctuations which remain quite unexplained.

The author's general conclusion from his experiments is that while the highest transpiration figures per hour in the tropics are considerably higher than any north European ones, yet active transpiration begins later and stops earlier in the day in the case of a damp tropical climate, so that the daily average is no higher than in Europe, while in the wet season transpiration may cease for weeks at a time. He thus does not disagree with the conclusions either of Haberlandt or of Giltay on this question. Dr. Holtermann holds that water-tissue is essentially an arrangement to supply water to the transpiring tissues during these short periods of excessive evaporation, not a means of lessening transpiration, and this view he supports by showing that it is especially developed in actively transpiring plants liable to be subjected to these sudden demands. It is characteristic of the leaves of tropical plants growing in a climate which is neither quite xerophytic nor constantly moist, and this harmonises with the short daily period of very active transpiration already mentioned. The mangroves, which ordinarily possess characteristic water

tissue well developed, form much less or none at all in the leaves of examples cultivated in garden soil, which transpire very much more freely than plants growing in the natural salty soil. If these plants cultivated without salt are now watered with 3 per cent. salt solution and placed in the sun, they show a wilting of the leaves, and the mesophyll becomes shrivelled. Mangroves growing in their natural habitat also show wilting on hot afternoons, but only the water-tissue is partially emptied and the leaves recover during the night. For the rest the author holds that the xerophily of mangroves and of other halophytes has been much overrated by Schimper and others. They are scarcely, if at all, more protected in this respect than many trees growing in similar situations but not in a salty soil.

Dr. Holtermann describes three other formations of strand-plants besides the mangroves, viz., first the plants of moist sand, which fall into two categories, (1) those growing on the edge of the sea, absorbing salt water, and possessing water-tissue; (2) those growing further from the sea, with fresh bottom-water, which have no special xerophilous adaptations. Secondly, the dune plants, a highly xerophilous type; and, thirdly, the plants growing on salty mud, which have internal water-tissue, and resemble succulent desert-plants in many anatomical features. These three formations have close parallels among the strand formations of temperate regions. This classification is good so far as it goes, but it ignores the beach-jungle (*Barringtonia*-formation of Schimper), which the author apparently includes with the damp lowland forest type. Yet this formation, though not well developed in Ceylon, certainly has an independent existence; it is much in need of exact study and delimitation.

The author goes on to describe the damp lowland woods, the dry plains of the north and east, and the upland vegetation, as also the epiphytes and parasites of Ceylon. Many interesting observations are contained in this part of the work. Dr. Holtermann also discusses at some length the question of leaf-fall in the tropics, and concludes that though it is a hereditary character, it is, in the endemic species, determined by the dry season, and, in general, leaves fall when their structure does not fit them to withstand the conditions prevailing during the time the trees are bare. A similar explanation is given of the occurrence of annual rings of growth in the wood, the author relating the renewed formation of wide xylem elements to the increased transpiration taking place when a crop of young leaves is produced.

The final section of the work is devoted to a discussion of "Direct Adaptation," in the course of which an account is given of many interesting experiments which add considerably to our knowledge of adaptive reactions under new conditions. The author rightly classes all these as phenomena of irritability, but draws the conclusion that such characters, acquired during the lifetime of the individual, can in process of time be fixed and inherited. This conclusion is, of course, wholly unwarranted; in fact, it is totally irrelevant. And meanwhile the mystery of

adaptive reaction, so widespread a phenomenon in the biological world, remains unsolved. Until we know a great deal more than we do at present about the physico-chemical connection of stimulus and response it is likely to remain so.

A. G. T.

CLIMATE AND MAN.

The Pulse of Asia: a Journey in Central Asia illustrating the Geographic Basis of History. By Ellsworth Huntington. Pp. xxi+416. (London: A. Constable and Co., Ltd.; Boston and New York: Houghton, Mifflin and Co., 1907.) Price 14s. net.

IN NATURE, vol. lxxii., 1905, p. 366, some account was given of the expedition of the Carnegie Institution of Washington to Eastern Persia and Turkestan. Mr. Huntington showed his descriptive power in the joint memoir issued in that year; and he dedicates his new book to Prof. W. M. Davis, his instructor in the "rational science" of geography, and his companion in arduous travel. Mr. Huntington states that, thanks to the help of Prof. Davis, he spent three years in Central Asia, in addition to four previously spent in Asia Minor. His study of languages has again and again been of service to him; and it is interesting to note at one point (p. 153) the struggle between his natural sympathy and the need for a little self-assertion, which, to the Oriental, is an outward sign of self-respect. His relations with the Khirghiz, and even with the feebler Chantos, were pleasant in the extreme; we fancy that something more fundamental than a training in geography gave him his thoughtful perception of the conditions and limitations of their lives.

The map of Asia, and no small part of it, is required to reveal the significance of the author's routes. The high passes of the Kwen Lun and Tian Shan ranges are mere incidents in these loops of travel, which lead us from Batum across Bokhara, and as far east as the shrinking salt-lake of Lop Nor.

Nine months were spent in the Lop Basin alone, and one of the finest things in the book is the general account of the succession of physical and climatic zones (chapter iv.), as one descends from the mountains across a ring of river-gravels to the edge of the region of desiccation. Here the fine sands and muds of old flood-plains are to-day whirled up before the wind, and are deposited as loess on the mountain-pastures to the south. The life of the nomadic inhabitants of the basin is practically limited by this pastoral land, which occupies all but the highest parts of the plateau-zone; and this zone terminates in steep slopes inwards, rising "like a continental ring around a sea forever dry." Down below, patches of forest-land are already poisoned by salt, and dying tamarisk bushes mark the spread and triumph of the desert.

All through Mr. Huntington's chapters we trace the same compelling influence. The desert, with its rippled and shifting dunes, its "hateful haze" swept onward by the wind, its inexorable hostility, demanding an inexorable endurance (p. 260), is driving man steadily before it, and has him, as it were, over leagues of country, by the throat. Old irrigation-channels have been abandoned, from failure at their source;

old roads around lake-basins have given place to direct tracks across their floors. Even in mountain-gorges, streams have run dry, leaving the lower ground dependent on the sudden and dangerous torrents that follow on each melting of the snows. Springs may temporarily arise in desiccated areas, and may furnish real rivers as time goes on (p. 182); but such incidents only temporarily retard the retreat of man, who leaves lost cities behind him, still "beautiful in the clean, graceful shrouds of their interment in the sand." Archæological research, local legends, the experience of recent generations, all show that the drying up of Central Asia is a continuous phenomenon; yet a "climatic pulsation" in an opposite direction is traceable, both in the Caspian and Lop Nor Basins, in the "Middle Ages" following on 500 A.D.

The conditions of the still older dry or "interfluvial" epoch have not even now been reproduced, since (p. 351) there are places in the Tian Shan range, now too cold and wet for agriculture, where canals were once made to provide for irrigation. Mr. Huntington throughout acknowledges the work of Brückner and his other predecessors in these fields of travel, observation, and deduction, and has, in his later pages, urged the climatic aspect of human movements to an almost hazardous extreme. He set out (p. 6) to use Central Asia as a text "to show the immense influence which changes of climate have exerted upon history." In this respect his book does not quite rise to the anticipated level, which is reached more nearly in the memoir issued by the Carnegie Institution. But, with its simple record of perilous adventures, its excellent illustrations, and its clear devotion to science first of all, it forms a noteworthy and inspiring work of travel. Throughout it we feel, as the author means us to feel, the insistent pressure of natural law against the will and work of mortals—the helplessness of millions of men against the untimed pulse of Asia.

GRENVILLE A. J. COLE.

THE MODERN MICROSCOPE.

Microscopy: the Construction, Theory, and Use of the Microscope. By E. J. Spitta. Pp. xx+472; 16 plates. (London: J. Murray, 1907.) Price 12s. 6d. net.

MICROSCOPISTS are at present divided into two factions. There are those of the old school, who are content with the principles under the guidance of which such great improvements have been made in microscope construction since the earlier days of Abbe; and there are those whom we may call the "Gordon rioters," who hold that Abbe's experiments were inconclusive and even misleading, and have found a new prophet. The new theory—the adjective has at least some justification—has been duly set forth, with a mint of strange phrases, in Sir A. E. Wright's "Principles of Microscopy," already reviewed in these pages (vol. lxxv., p. 386, February 21, 1907). Mr. Spitta is of the older school. He is for "legitimate methods of observation." He casts an oblique and somewhat mistrustful glance upon the new practices, and hurries by to surer and more familiar ground.